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Be it known that I, Alexander L. Cheng, a citizen of the Republic of China (Taiwan), residing at 11 Springdale Avenue, White Plains, New York, 10604, have invented new and useful improvements in a:

of which the following is a specification.

# METHOD AND APPARATUS FOR PARALLEL OPERATION IN A MULTIPLE ACCESS NETWORK

## Field Of The Invention

The present invention pertains generally to multiple access communication systems, and more specifically to a method and apparatus for improving quality-of-service (QoS) of a multiple access network.

## Background of The Invention

The communication protocol provides the rules for communication. The protocols govern the behavior of each communicating node on how to access the network, how to signal other nodes of its current situation and need, how to transfer data, and unique to a multiple access network, how to detect and resolve contention (often called collision). To help manage the complexity of a communication system, it is customary to divide the functionality of a communication system in layers of protocols. The International Standard Organization has specified seven layers from lower to higher: physical, media access control (MAC) or link, network, transport, session, presentation, and application layers. The present invention deals mostly with the physical layer for multiple channels and the MAC layer protocol for access. The management issue, including quality-of-service (QoS) policy, is a concern to be dealt with by the higher layer protocol. The bandwidth of communication network is normally separated into two types of channels--signaling and traffic bearer. In some multiple access networks, e.g. Carrier Sense Multiple Access with Collision Detect (CSMA/CD), these two types of channels are one and the same.

Communication systems with multiple access network have been providing satisfactory services in many markets, such as local area network (LAN), cellular telephony, and more recently broadband network based on CATV infrastructure. More recently, galvanized by the potential of a broadband network, cable modems conforming to CableLabs' Data Over Cable Service Interface Specification (DOCSIS) have been deployed in increasing numbers. These multiple access protocols provide satisfactory services when the network load is light (actually

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- Reduced group for contention resolution with parallel operation to speed up contention resolution process;
- Support of different service quality levels based on varying group size;
- Compatibility with existing protocol; and
- Smooth growth path for protocol and network facility.

#### Brief Description Of The Drawings

Figure 1 depicts a typical multiple access communication system.

Figure 2 illustrates logical flow diagram of communicating nodes.

#### Detailed Description Of The Preferred Embodiment

As illustrated in Figure 1, a plurality of nodes 10 are connected to a multiple access network 20, which is further divided into a plurality of communicating channels 30. In addition to the communication channel(s) of the physical layer protocol of an existing protocol, a plurality of communicating channels can be constructed using many different means, such as with separate time slots, different frequency band, coding scheme, separate physical media, or a combination of the above.

The allocation of these contention resolution channels can be performed dynamically based on the network condition and the capabilities of the communicating nodes. For example, when only a subset of the communicating nodes have access to a separate contention resolution channel, these nodes can use this contention resolution channel independent from the others for contention resolution process. Assignment of these contention resolution channels to the nodes can also be executed dynamically based on the network condition, resources available, network load, node behavior and QoS policy, etc.

Upon detection of a collision, nodes involved in the contention will switch to their assigned contention resolution channel. The contention-resolution protocol can be based on either a new protocol designed specifically for contention resolution or the original protocol, i.e., exponential back-off with random interval in the case of CSMA/CD, or contention polling

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in case of U.S. Patent No. 5,563,883. The nodes not involved in the contention and the nodes not having implemented the contention resolution channel scheme will continue with their normal operation on the regular channel with the existing protocol. This method allows a backward compatibility for communication nodes using existing protocol while offering a smooth migration for enhanced implementation.

In the case of U.S. Patent No. 5,563,883, the improvement of the contention resolution process is from  $\log_2 N$  to  $\log_2 N/X$  given there are  $X$  spare contention-resolution channels, which are equally distributed to all  $N$  nodes, which have the same probability of engaging in a contention. Meanwhile, the regular traffic is not interrupted.

It should be noted that, given that the same protocol is used in both regular and contention-resolution channels and the communicating nodes sharing the same behavior pattern, the patented multiple access system exhibits the same behavior probabilistically in the worst case. The improvement of network performance is derived from either the separation of communicating nodes into smaller group, or improved channel characteristics, i.e., transmission speed and quality. The present invention enables more efficient communication in reasonably loaded network while offering facility to provide different QoS levels.

From the foregoing, it will be observed that numerous variations and modifications may be effected without departing from the true spirit and scope of the novel concept of the invention. It should be understood that no limitation with respect to the specific structure and circuit arrangements illustrated is intended or should be inferred. It is, of course, intended to cover by the appended claims all such modifications as fall within the scope of the claims.

Thus, in accordance with the invention, a Method and Apparatus for Parallel Operation In A Multiple Access Network has been provided accomplishing all of the objects, and having the features and advantages specified at the beginning of this specification. It is to be understood that the disclosed construction of the invention may be embodied in other forms within the scope of the claims.

What is claimed is:

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